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> 100 and < 167 with the exceptions noted above are all regular and the last theorem is proved for these exponents p .

¹ *Göttingen Nachrichten*, 1910 (507-16).

² These PROCEEDINGS, 6, 1920 (266).

³ *Trans. Amer. Math. Soc.*, 4, 1903 (201-12).

⁴ Hilbert, *Die Theorie der Algebraischen Zahlkörpers*, p. 430.

⁵ Hilbert, *l. c.*, p. 429.

⁶ *Crelle*, 111, 1893 (26-30).

⁷ *Ibid.*, 140, 1911 (29).

⁸ *L. c.*, pp. 482-88.

⁹ *Abhandlungen Berlin Academy*, 1857, p. 73, verification of 2nd assumption.

¹⁰ Kummer, *l. c.*, pp. 63-5.

¹¹ *Crelle*, 40 (93-139).

¹² *Berlin Monatsberichte*, 1874.

¹³ Hilbert, *l. c.*, pp. 429, 435.

OBSERVATIONS ON THE STERILITY OF MUTANT HYBRIDS IN *DROSOPHILA VIRILIS*

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Communicated by C. B. Davenport, May 28, 1920

In an earlier paper¹ by Metz and Bridges, attention was called to two cases of apparent incompatibility between mutant races in *Drosophila*. One of these cases involved my data on the sex linked characters rugose and glazed in *Drosophila virilis*. Subsequent to the publication of this paper another character appeared in *D. virilis* that shows the same relations to rugose and glazed that they do to one another.² A study of these three characters has brought out some interesting relationships and has apparently revealed an error in the previous publication that should be corrected.

It may be recalled that hybrids between rugose and glazed were invariably sterile, while supposedly pure stock of each mutant was fertile and hybrids of either with other mutant stocks were fertile; hence it was concluded that rugose and glazed were incompatible. It appears now that a mistake was probably made in the statement that pure stocks of both rugose and glazed have normal fertility. Apparently this should have applied only to rugose, for later work has shown that females homozygous for glazed are usually sterile and that pure cultures cannot be maintained—at least without great difficulty. Possibly this condition has arisen by the secondary appearance of sterility factors in the stock since the previous paper was written, but more probably the earlier stock was impure, at least part of the time—the impurity having been overlooked through confusion with rugose in which the homozygous females are somatically normal. Unfortunately no accurate records of stock

bottles were kept, so the point cannot be definitely settled; but in any event the present degree of sterility in glazed stock suggests an interpretation of the sterility of the hybrids which differs considerably from that advanced previously. This is emphasized even more by the behavior of the third character, wax, as will appear below.

The three (allelomorphic?)² mutants, rugose, glazed and wax, form a graded series in respect to their morphological characteristics and also in respect to fertility, but contrary to expectation the order of dominance of the somatic manifestations appears to be just the reverse of that of fertility. These features may be brought out more clearly by a brief summary of the salient points. I am indebted to Dr. Alexander Weinstein and Miss Eleanor D. Mason for obtaining many of the records involved here.

1. *Rugose*; characterized somatically by a slight paling and a roughening of the eye, evident only in the male, the female being entirely normal in appearance; in fertility both sexes seem to be fully equal to the wild type stock, as determined by a large number of matings and by the behavior of the pure stock cultures.

2. *Glazed*; more extreme in all respects; the eyes have a glazed appearance in both sexes, although the males are more noticeably affected; as noted above the females are usually sterile; among approximately 150 females tested³ 3 were fertile, giving respectively 6, 7 and 8 offspring;⁴ apparently the males are also affected somewhat, for they do not breed as well as do rugose males.

3. *Wax*; still more extreme; the eyes of both sexes are greatly affected, resembling masses of yellow wax; the females seem to be practically or entirely sterile; among approximately 100 tested no certain case of fertility was found. One bottle gave a single normal female, another gave a normal female and wax male. The first case is probably due to contamination, and the latter may be accounted for in the same way, although the presence of the wax male adds to the probability of actual, but very low, fertility here. The males, in turn, appear to breed more poorly than do the glazed males.⁵

4. *Hybrid females*⁶ from *rugose* \times *glazed*; somatic appearance normal as in rugose females; many tested, all sterile. (See Metz and Bridges, loc. cit.)

5. *Hybrid females* from *rugose* \times *wax*; somatic appearance normal as in rugose females; approximately 100 tested, one fertile, giving 19 normal females, 8 rugose males and 5 wax males.⁷

6. Hybrids of rugose, glazed or wax with any other mutants thus far used are all fertile.

Reviewing these results it is seen that in each hybrid involving rugose and either glazed or wax, rugose is dominant as regards somatic manifestation. But the sterility of the hybrids seems to indicate that the fertility

of rugose is recessive to the sterility of both glazed and wax. In the glazed-wax hybrid a similar relation holds for the somatic effect, glazed being dominant to wax. The high degree of sterility in both homozygous parent forms here, however, would naturally call for the observed sterility of the hybrid and eliminates the question of dominance with respect to this feature.

From the above standpoint sterility in the rugose-glazed and rugose wax hybrids is accounted for by assuming the dominance of sterility instead of assuming an incompatibility as was done in the previous paper when only the rugose-glazed hybrids were known. The present explanation calls for the occasional occurrence of fertile hybrids between rugose and glazed to correspond to the occasional fertility in pure glazed females. No such fertile hybrids have been obtained thus far, but this may be due merely to chance, since only a very few of them would be expected in the number of females tested. This conclusion is made still more probable by the occurrence of the one fertile hybrid between rugose and wax.

¹ These PROCEEDINGS, 3, 1917 (673).

² These three characters are almost certainly allelomorphs, although the sterility of the hybrids and the dominance of the normal somatic constitution of rugose females makes it difficult to demonstrate the fact for the latter character. See Metz, C. W., *Genetics*, 3, 1918 (116).

³ The females were tested both singly and in mass cultures. The use of some mass cultures prevents recording the exact number of flies actually tested, for in these a few females may have died before they had a chance to breed.

⁴ In each case these are such as to indicate fertility, not contamination or non-disjunction. In one case both parents were glazed, the offspring being 3 glazed females and 5 glazed males.

⁵ It is difficult to obtain accurate determinations of the relative degrees of fertility of the males in these cases, for even the wax males breed fairly well, but in general the relations seem to be as described.

⁶ Since the characters are sex linked and apparently allelomorphic no truly "hybrid" males can be obtained.

⁷ In this and the preceding experiment offspring were obtained from two or three other bottles, but they were such as to indicate that they probably came from females heterozygous for one factor only, due to non-virginity or contamination.

*STUDIES ON THE TRANSFORMATION OF THE INTESTINAL
FLORA, WITH SPECIAL REFERENCE TO THE IMPLANTA-
TION OF BACILLUS ACIDOPHILUS. I. FEEDING EX-
PERIMENTS WITH ALBINO RATS*

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The type of bacteria developing in the alimentary tract may be influenced in a noteworthy manner, not only through special alterations